****Miss Mary Wanjiku received about 2.5 acres of uncultivated land from the Kenyan government one year ago and set out to make a living as a farmer. Mary’s farm is busy with 3 dairy cows grazing on pastures and a field of 1 acre planted with tomatoes. She sells the products on the local markets.

Country Case Card – Kenya

Water Requirement Tool, Pump Sizing Tool,   
Simplified Financial Viability Tool, Farm Analysis Tool, Soil Tool



Mary’s asset portfolio boasts of several equipment including a small warehouse, a tiller and a livestock shed. Most of the equipment was purchased from a loan which she took in the beginning of the year. Labor is provided by family members for free during peak periods i.e. planting and harvesting. However, two employees earning KES 18,000 each per month are stationed in the farm for half a year to ensure smooth operations during the labor intensive periods.

* Mary pays a monthly KES 4,000 as land tax and KES 1,000 for a local savings group.
* To date, the farm has bought a total of 60 kg in local seeds at average price of KES 100 per kg. 70 kg of fertilizer (priced at KES 50 per kg) and 150 liters of herbicides (priced at KES 200 per liter) have gone into the farm.
* Fuel for machinery (planting, harvest, processing) is at KES 79 per liter. For one planting season approximately 50 liters are needed. Per planting season, repair and maintenance costs of KES 30,000 occur.
* The milk yield per year results in an average daily yield of 10 liters per cattle with the market price being KES 50 per liter.

Farm Analysis

* What is the farm’s gross income? 942.750 KES
* What is the farm’s total expense? 812.975 KES
* What is the farm’s total variable cost? 499.845 KES
* What is the farm’s gross profit? 129.775 KES
* What is the highest variable cost? Labour

During her time as a farmer, Mary has seen the weather change for the worse, making it hard to succeed with her farm. “When the rains were good we had good harvests”, she remembers from her childhood years. But nowadays the rains are unpredictable and unevenly distributed. She is considering utilizing intensive irrigation from now forward, using an earth canal supplied flood irrigation system. This would give her the opportunity to start a second growing period in September.

First planting period is in the beginning of March.

Water Requirement

* Only one growing season, starting in March (flood irrigation):
  + In which month is the highest irrigation water need? June
  + What is the total highest daily irrigation water need? 30,3 m³
* With a second growing period with planting in September (flood irrigation) :
  + In which month is the highest irrigation water need? June
  + What is the total highest daily irrigation water need? 30,3 m³
* What is the highest daily water pumping need, for the two growing periods (if she would use micro sprinkler irrigation) and for her dairy cows? 26,2 m³
* What is the pump utilization rate when having one or two growing periods under micro sprinkler? 24% for one harvest, 54% for two harvests

****

You do a first calculation after which Mary decides for a micro sprinkler system and will prospectively implement a second growing season. She can use a well and would be pumping water from it to an elevated tank some distance away. She will then use the water from the reservoir for both irrigation and filling the water troughs for her livestock. Measurements show that the groundwater level is at 20 m. The drawdown when extracting water is 2 m. To store the water, Mary uses a water tank (inlet: 7 m, outlet: 5 m). The elevation between well and tank structure is 3 m. The length of the piping system from the pump to the inlet is 100 m. She uses a PVP-tube with a diameter of 1 ½" and with three 90° elbows in total. A water meter and fertigation / filter system are installed, the head loss in each one of these is 2 m.

The manufacturer’s datasheet for sprinkler irrigation shows pressure requirements of 0.5 bar.

Pump Sizing

* What is the Total Dynamic Head of the pumping system? 42 m
* Which is the lowest power (kWp) required (solar deration losses of 25 %)? 1,8 kWp
* How big is the surface of solar panels to be installed? 12 m²
* From a neighbor who changed the water system, Mary could get PVP-tubes of 1” for free. Should she accept this friendly offer? No, the smaller diameter increases the Total Dynamic Head and will lead to a much more expensive system.

The soil on Mary’s farm is silty and she knows from neighbouring farmers that she does not need to water tomatoes every day.

She figures that she might need a tank to store water so that she has more control over when to irrigate.

Soil

* What is the shortest frequency she needs to irrigate the tomatoes? every 6 days
* Which is the minimum water storage capacity needed if she irrigates daily? 26m3

Mary is considering various options for undertaking the daily water pumping in order to satisfy the water need for her tomatoes. Using irrigation, she will improve the current yield by 50%, while also adding an additional harvest. Three employees now work the whole year on the farm. You used the Farm Analysis Tool to project her new profit, which will be at 523,911 KES / year. Now she can determine how solar compares to other pumping options.

Financial Viability

* What it the initial investment cost for each option:
  + Solar? 880.000 KES Grid? 350.000 KES Diesel? 510.000 KES
* What is the internal rate of return (IRR) for each option:
  + Solar? 55% Grid? 143% Diesel? 71%
* What is the break-even point for each option:
  + Solar? About 2 years Grid? About 1 year Diesel? About 1 year
* When does solar break-even with diesel and grid? Diesel: 2,5 years; Grid: never





**Location Data**

Country Case Card II – Kenya

Data Sheet



|  |  |
| --- | --- |
| Country | Kenya |
| Location | Taita Taveta |
| Longitude | 38.55 |
| Latitude | -3.33 |
| Exchange rate | 10,000 KES = 85 € |

**Climate Data**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| **Mean daily temperature in °C** | 25.5 | 25.0 | 24.6 | 23.8 | 23.9 | 23.5 | 23.0 | 23.0 | 23.6 | 23.9 | 23.6 | 23.8 |
| **Rainfall in mm/month** | 45.0 | 33.0 | 69.3 | 142.8 | 109.8 | 38.1 | 27.0 | 21.6 | 18.3 | 48.3 | 97.2 | 86.1 |
| **Solar irradiation in kWh/m² day** | 6.2 | 6.6 | 6.0 | 5.3 | 4.6 | 4.3 | 4.4 | 4.7 | 5.6 | 5.9 | 5.6 | 5.8 |

**Assets and equipment**

|  |  |  |
| --- | --- | --- |
| Item | Current Value (KES) | Age |
| Tiller | 50,000 | 1 |
| Livestock Shed | 250,000 | 1 |
| Warehouse | 250,000 | 1 |

**Economics and financing**

|  |  |  |
| --- | --- | --- |
| Inflation | 11.48 % |  |
| Discount rate | 16 % |  |
| Annual profit margin increase | 1 % |  |
| Annual fuel price increase | 3.84 % |  |
| Alpha Bank Loan | Amount | KES 600,000 |
| Credit Period | 3 years |
| Annual interest rate | 16 % |

**Crop Acreage and yield**

|  |  |  |  |
| --- | --- | --- | --- |
| Crop | Cultivated area (acre) | Estimated yield per season (kg per acre) | Estimated market price (KES per kg) |
| Tomatoes | 1 | 20,000 | 25 |

**Livestock and milk yield per day**

|  |  |  |  |
| --- | --- | --- | --- |
| Livestock | N. of livestock | Estimated milk yield per day (l per cow) | Estimated market price (KES per l) |
| Dairy Cows | 3 | 10 | 50 |

**Solar components**

|  |  |  |
| --- | --- | --- |
| **Solar Option** | **Costs in KES** | **Life span in years** |
| **Solar panels** | 400,000 | 20 |
| **Control unit** | 50,000 | 5 |
| **Motor pump** | 250,000 | 5 |
| **Wires / tubes** | 20,000 | 5 |
| **Water storage** | 55,000 | 20 |
| **Irrigation system** | 80,000 | 5 |
| **Installation cost** | 25,000 |  |
| **Maintenance cost** | 6,000 / year |  |

**Grid components**

|  |  |  |
| --- | --- | --- |
| **Grid Option** | **Costs in KES** | **Life span in years** |
| **Motor pump** | 150,000 | 5 |
| **Wires / tubes** | 50,000 | 5 |
| **Water storage** | 55,000 | 20 |
| **Irrigation system** | 80,000 | 5 |
| **Installation cost** | 15,000 |  |
| **Maintenance cost** | 5,000 / year |  |
| **Electricity cost** | 20.73 / kWh |  |
| **Pump electricity demand** | 0.75 kW |  |
| **Pump water output** | 6 m3 / hour |  |

**Diesel pump components**

|  |  |  |
| --- | --- | --- |
| **Diesel Option** | **Costs in KES** | **Life span in years** |
| **Diesel Generator** | 150,000 | 3 |
| **Motor pump** | 150,000 | 5 |
| **Wires / tubes** | 50,000 | 5 |
| **Water storage** | 55,000 | 20 |
| **Irrigation system** | 80,000 | 5 |
| **Installation cost** | 25,000 |  |
| **Maintenance cost** | 30,000 / year |  |
| **Diesel cost** | 79 / liter |  |
| **Pump diesel demand** | 1 liter / hour |  |
| **Pump water output** | 6 m3 / hour |  |
|  |  |  |
|  |  |  |